magined the shaft to be a box full of liquid, which, if rotated, would leave the latter behind somewhat, and the apices would cause two stresses—tangential and centripetal—to act on the particles, the former only being of momental value."

Now what is the student, whether at the New Cross Institute or elsewhere, to make of this without further explanation? To introduce St. Venant and say no more than this, is surely giving either too much or not enough. The same criticism might be repeated at many other places. Under the heading of "Pillars and Struts," we are told that Euler is pronounced Oiler (this, at least, is nothing if not practical), and his formula for the stability of long columns is quoted without explanation. Gordon's formula and constants are also quoted, and the subject is dismissed with the dictum:

> "Claxton Fidler says a pillar-strength cannot be an absolute quantity, but may be anywhere between Euler and Gordon's results."

The theory of heat engines is treated in an equally scrappy and inconclusive fashion. The student will not find it easy to reconcile what he is told on p. 609 as to the efficiency of the engine not depending on the working substance, with the statement, on p. 613, that "in practice it is difficult to find a sufficiently perfect substance"—which is given as a reason why the efficiency of a real engine is less than the efficiency in Carnot's cycle. He will find himself also at a loss to understand the statement that "in adiabatic expansion external work is done at the expense of internal heat, and is therefore negative"; or to see why the dryness fraction of steam is necessarily "a whole number" (p. 594). Again, to take a matter of first-rate importance in regard to the action of steam in the cylinder, initial condensation is spoken of as if it affected the efficiency merely by the trifling alteration it produces in the form of the expansion curve, and we do not find a hint as to the real reason for its highly prejudicial effect.

It would be unfair to conclude that all the theoretical portions of the book are equally unsatisfactory. But at the best, their brevity, and the narrow limits of mathematical knowledge which the author assumes on the part of his readers, make this part of the work more like an engineering pocket-book than a treatise, the purpose of which ought to be to educate the student to reason about the application of mechanical principles to engineering. If the book, in this aspect, is representative of the teaching which the new Polytechnics are giving, it suggests the inquiry whether what Lord Armstrong once called "the vague cry for technical education" has met with the best possible response. We have no sympathy with those who would exclude either engineer apprentices or any other workmen from the highest education they are capable of. But the question may fairly be asked whether a good deal of what is apparently taught, and taught for the express purpose of enabling pupils to pass a specified examination, is in any just sense education at all. The mental discipline which would be obtained by making a real study of problems such as are touched on in this book, would be of the highest value as an education to the engineer. But there is no royal road to the comprehension of elasticity and thermodynamics. If the young apprentices and working lads, who, much to their credit, flock to the new Polytechnics, will take the trouble to truly master any of these things, they will gain an intellectual possession which will make them better men, if not directly better workmen. We would be the last to set a bound to their aspiration, or to discourage the study of Euler and St. Venant. But as a preparation for any such task, they must first, let us say, learn what is the meaning of a differential coefficient. To offer them scraps of conclusions which have to be taken on trust, and "reasons" which can carry conviction to no one except perhaps a jaded examiner, is giving stones to children who presumably cry for bread. If this represents the "theoretical" side of technical education as the new technical schools understand it, or as examiners accept it, we are still some way from a satisfactory solution of the much-vexed problem. For a great deal of this does not usefully instruct, and does not effectually educate: it is, as we have said, either too much or not enough.

THE LAKE OF GENEVA.

Le Léman Monographie Limmologique. By F. A. Forel. Tome second. (Lausanne: F. Rouge, 1895.)

THE first volume of Prof. Forel's work on the Lake of Geneva appeared in 1892, and was reviewed in these pages (vol. xlvii. p. 5). It dealt chiefly with the physical history of the lake-basin, while the present one, containing parts 6–10 of the whole work, begins with "Hydraulics," or the currents, waves, *seiches*, and other deviations of the surface from the normal form of a fluid at rest. It passes on to thermal questions, such as the temperature at different depths, freezing of the surface, &c.; next to optical questions, such as the colour, occasional iridescence and other peculiarities of the water, and the phenomenon of the *Fata Morgana;* then to acoustics (briefly); and lastly, to the chemistry of the water.

As it is impossible, in the limits of a comparatively short notice, to deal with the numerous subjects included in the present volume, we shall restrict ourselves to those which, perhaps, may be more widely interesting than the rest. The first one concerns those curious oscillations of the level of the lake, which locally are called *seiches.* This phenomenon, as defined by Prof. Forel, consists in an alternate rise and fall of the surface of the water; the movement being roughly comparable with that of a balanced plank, when set swinging by a slight disturbance. These oscillations are more or less rapid; their amplitude varying much. Commonly it is only a very few inches; but it may amount, though rarely, to about six feet—the disturbance sometimes lasting for twenty or twenty-five minutes. The whole question is discussed by Prof. Forel in its various aspects, and a history given of the different explanations which have been advanced. He attributes it neither to the effect of storms, nor to that of wind, nor to that of varying atmospheric pressure, but to a disturbance of the whole mass of water by earth-tremors, and compares it to the effect which may be produced on a fluid contained in a flat dish by tapping the bottom. In this hypothesis, however, he frankly admits the existence of a difficulty; namely, that earthquakes and

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seiches are not always associated, for in some cases the former have not been accompanied by the latter The difficulty is undoubtedly a serious one, and it is thus met by Prof. Forel. In an earthquake the undulatory movement is variable in character. In some cases it affects a pendulum seismograph, in others it does not; much depending on the rate at which the shock travels. If this be quick, it will not produce a perceptible undulation to a mass of water; if it be slow, it will set up a very sensible movement. Thus an earthquake of the latter type will produce a *seiche*, but not one of the former. There is much to be said in favour of this hypothesis; but further seismographic observations are required to show that there is a real coincidence between the nature of the earthquakes and the occurrence of the *seiches*.

More than one point of interest is discussed in the section dealing with optical questions. The Swiss lakes, as is well known, vary in colour, some having a distinctly green tint, but others, and especially the Lake of Geneva, being noted for the exquisite blue of the water. To facilitate comparative observation, Prof. Forel has constructed a scale of colours, beginning with sulphate of copper, as the pure blue, and representing the effects of chromate of potash added in proportions commencing with 2 and ending with 65 per cent. After a careful study of the whole question, he comes to the conculsion that the colour of the water depends not merely on the quantity of minute mineral matter present in a state of suspension, but also on the amount present in solution.

The third point, the chemistry of the water, is also very interesting. The author has collected together a large number of analyses already published, has added some others, and discusses the whole. These exhibit differences more considerable than we might have expected; for instance, the residue after evaporation varies from 160 to 218 mgs. per litre. These differences, allowing for possible errors, are probably due primarily to the affluents of the lake, the waters of which are long in becoming completely mixed with the main mass. The principal constituents of this residue are carbonate of lime, sulphate of lime, and carbonate of magnesia, the amounts being variable. Evidently they depend partly upon the time of the year, for in two samples, drawn from the same locality in January and in May, the numbers in the one case were as 3·3 : 2·6 : 1, in the other 3·7 : 1·4 : 1.

The volume, in short, is full of valuable matter, and worthy of its predecessor. As we said of that, it is a little too diffuse for a scientific treatise, but it was necessary, as the author then explained, to write it so as to attract a larger circle of purchasers.

T. G. BONNEY.

OUR BOOK SHELF.

A Catalogue of the Books and Pamphlets in the Library of the Manchester Museum. By W. E. Hoyle, M.A., F.R.S.E., Keeper of the Museum. (Manchester: J. E. Cornish, 1895.)

THIS catalogue, of 292 pp., owes its appearance in print to private enterprise, and is noteworthy as being classified according to the "Dewey Decimal System," under which each digit composing the registration number of a book marks a distinct narrowing in its significance, and for the arrangement under each class by Cutter's "Decimal Author Table," whereby each book receives a number which is virtually an abbreviation of its author's name. Thus, that "597·0941 Ya 21" denote the second, and "597·0941 Ya 2" the original edition of Yarrell's "History of British Fishes," may appear perplexing; but it is claimed by the advocates of the Dewey-Cutter systems that however much the library may grow, these numerical combinations will remain, and that they allow for maximum extension with minimum disturbance.

The classified catalogue upon which we have commented covers 230 pp., and is followed by a supplementary "author catalogue." The author modestly remarks in his preface, that the volume is "the work of one who is not a professional librarian." The labour of compilation has been great; and this catalogue, like all else that its author has put before the world, bears strongly the stamp of thoroughness and accuracy. We cordially recommend it to our university and public librarians, not, however, without a fear that they may adjudge it dangerous in its over-elaboration.

An index of subjects is appended, and Russian names have been transliterated according to the system advocated in our pages (NATURE, vol. xli. p. 396), and adopted in many of the principal scientific libraries.

A Course of Elementary Practical Bacteriology, including Bacteriological Analysis and Chemistry. By A. A. Kanthack, M.D., and J. H. Drysdale, M.B. (London: Macmillan, 1895.)

A LITTLE volume of 127 pages, primarily intended to carry candidates for diplomas in Public Health through a three months' course in bacteriology, and not pretending to be more than a laboratory guide. The instructions are extremely brief, and for the most part unaccompanied by any theoretical explanation. This entire divorce of theory and practice is, in our opinion, not unattended with danger, often leading the student to unintelligently cram the details of methods without having any proper understanding of the principles involved. It is frequently forgotten that the chief object of laboratory work should be to gain a living knowledge of a science, rather than the acquisition of mere dexterity in its practical technique. The exercises are, as we should anticipate from the experience and standing of the authors, well chosen, thoroughly representative, and cover a large amount of ground. On the other hand, some statements made without qualification may easily give rise to mistakes if accepted without reserve. Thus we are told that it is often possible to give a definite opinion in from eighteen to forty-eight hours, as to the presence or absence of cholera vibrios. Recent researches, however, go more and more to show that it is by no means so easy as was supposed to give a correct "definite opinion" as to the identity of this or any other particular micro-organism. We doubt whether bacteriology is sufficiently advanced to admit of treatment in quite such a final and hard and fast manner as it receives in this text-book; but we are told that these pages are not to supplant the demonstrator, and we would add that they should be carefully supplemented by the teacher. If thus employed, this work should prove a very valuable addition to the bacteriological literature of our country. Especially welcome is the inclusion of the principal methods for the detection of some of the chemical products of bacterial life.

Primer of Navigation. By A. T. Flagg. (London: Macmillan, 1894.)

MR. FLAGG'S little primer can be strongly recommended to all beginners; it is the A B C of the art of navigation. Every step is explained in the most simple and accurate manner; and for students depending upon self-instruction, a better or more clearly written primer would be difficult to imagine.

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